Modelling approach and tool

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Purpose of modelling

Meaningful assessment cannot be limited to capacity

> Since TYNDP 2011-2020, ENTSOG uses modelling based on supply assumptions

> The impact of a project is not limited to its capacity increment (otherwise no cross-border impact of UGS and LNG terminals)

Focus on infrastructure potential

> The approach assumes the efficient use of firm capacity under the 3rd package market structure (which is different from a single TSO approach)

> This approach may result in a possible underestimation of investment need which is not detrimental to the selection of PCI that should focus on the main investment gaps

Dependency on input data

> Results should be carefully analysed under the light of input data and methodology in order to avoid over/misinterpretation (e.g. in area of high flexibility many flow patterns may exist in addition to one provided by a modelling tool)

> The introduction of additional data (compared to TYNDP 2013-2022) strengthens the importance of the sensitivity-analysis in order to identify particular link between results and input data

Topology and objective function

Basic blocks of the topology

> Structured according to the concept of balancing zones

> Topology built on 2 items:

- Nodes:
  - Stand for balancing zones, gas sources (import sources, LNG terminals, UGS...), forks and interconnectors
  - The "demand" figures attached to nodes represent domestic exits from the network
  - They also stand for local supply sources (LNG, UGS, National Production)

- Arcs:
  - Directed interconnection between nodes
  - Different parameters can be attached to an arc:
    - Minimum and maximum possible flow through the arc
    - Cost of flow through the arc
    - « Loss » between 2 nodes

Objective function

> Minimization of the total cost of the flows through the arcs of the whole network

Example of topology
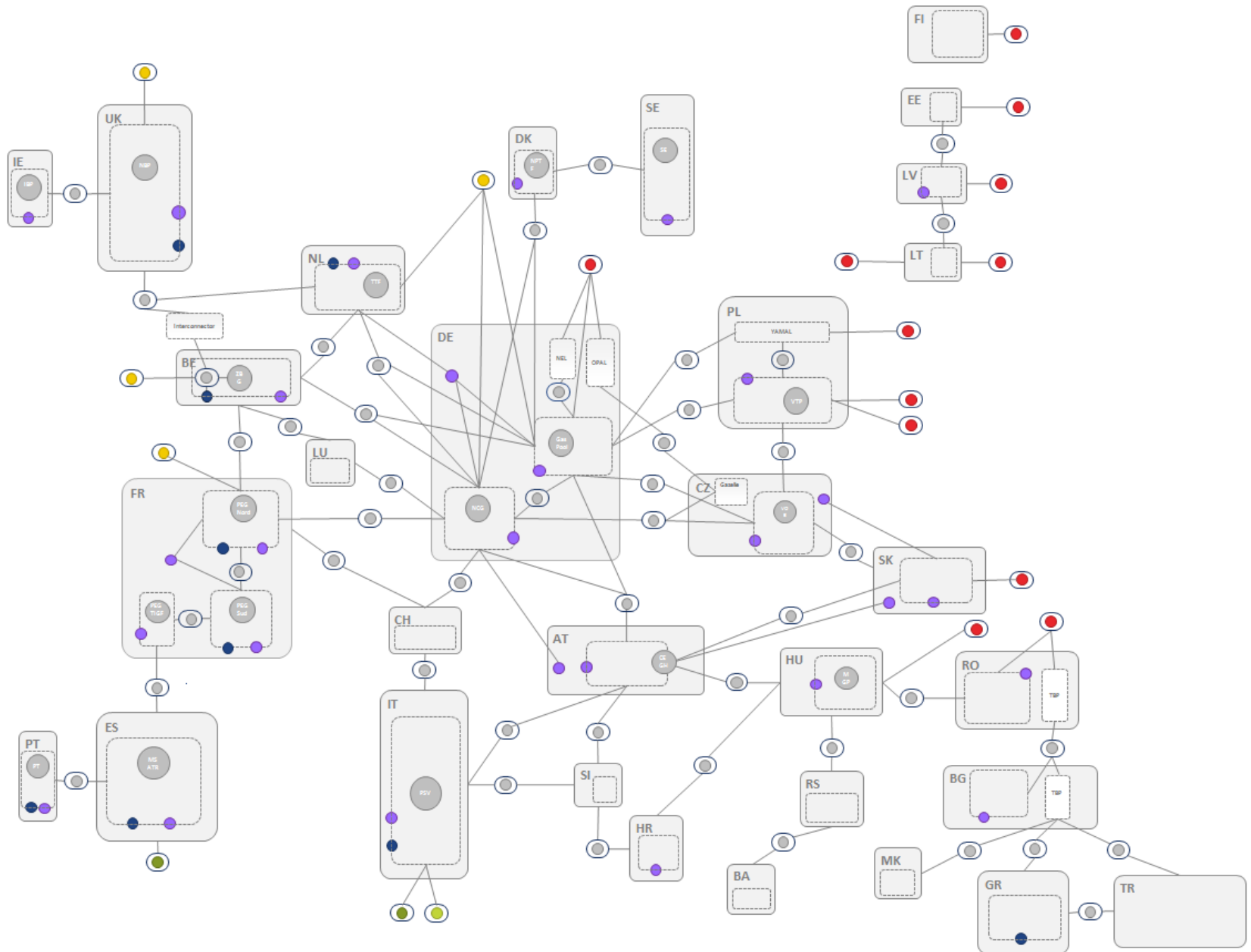
The software behind

Excel interface

> All input data for one simulation are gathered in a single Excel file:

- Interfaced with ENTSOG database
- All data can be modified in the file itself

> Output data also in Excel format including a summary of input data

Solver open source from Texas University of Austin

> Dedicated to linear network problem

> The solver does not influence the identified solution but the time to converge

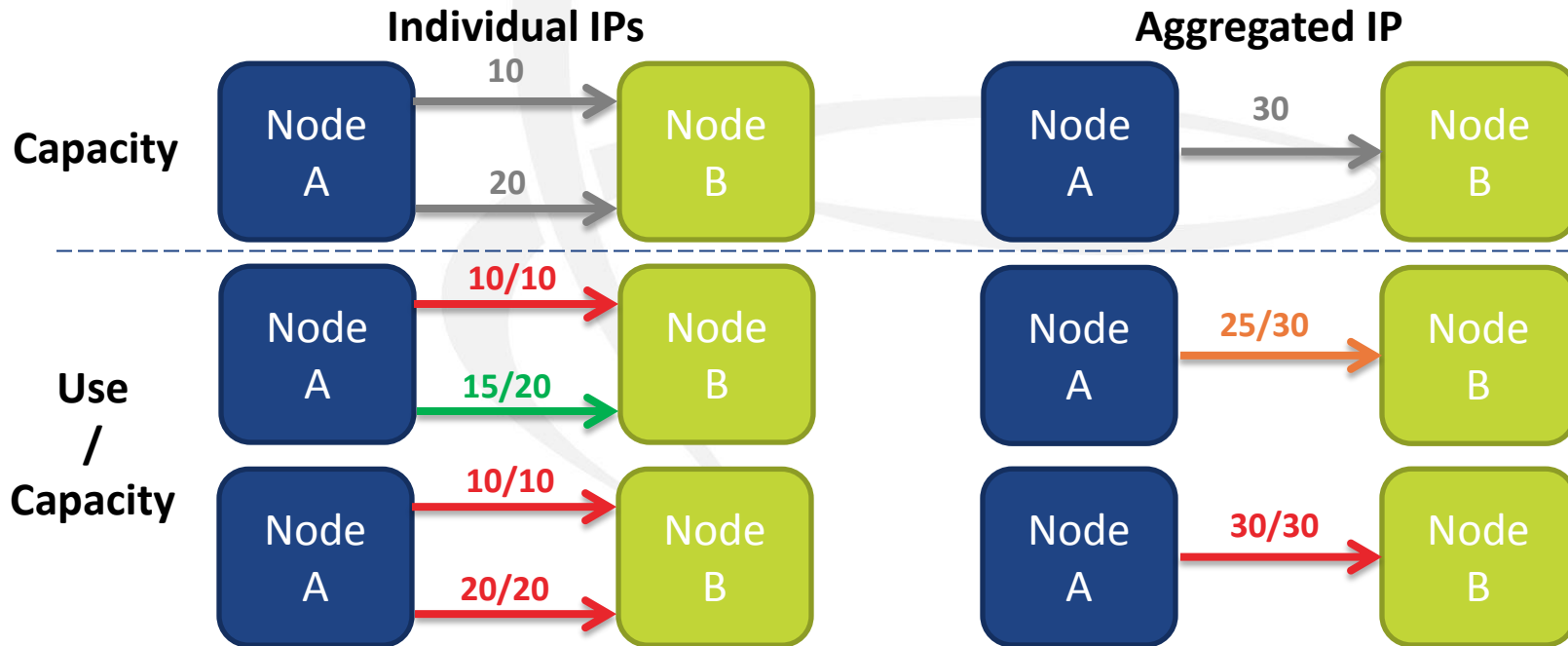## *Additional features developed by ENTSOG in Visual Basic Application*

> Uploading of input data and creation of the output file

> Underground storage management (level and deliverability)

> Functional enhancement (e.g. elasticity)

All the functional enhancements are achieved through an adaptation of the topology, and associated constraints, rather than a solver modification

Aggregation of Interconnection Points

Topology is based on capacity aggregation at balancing zone level

> Capacity of all IPs between 2 same balancing zones is summed and represented by one arc by direction

> This goes in the direction of hub-to-hub capacity and Virtual Interconnection Points

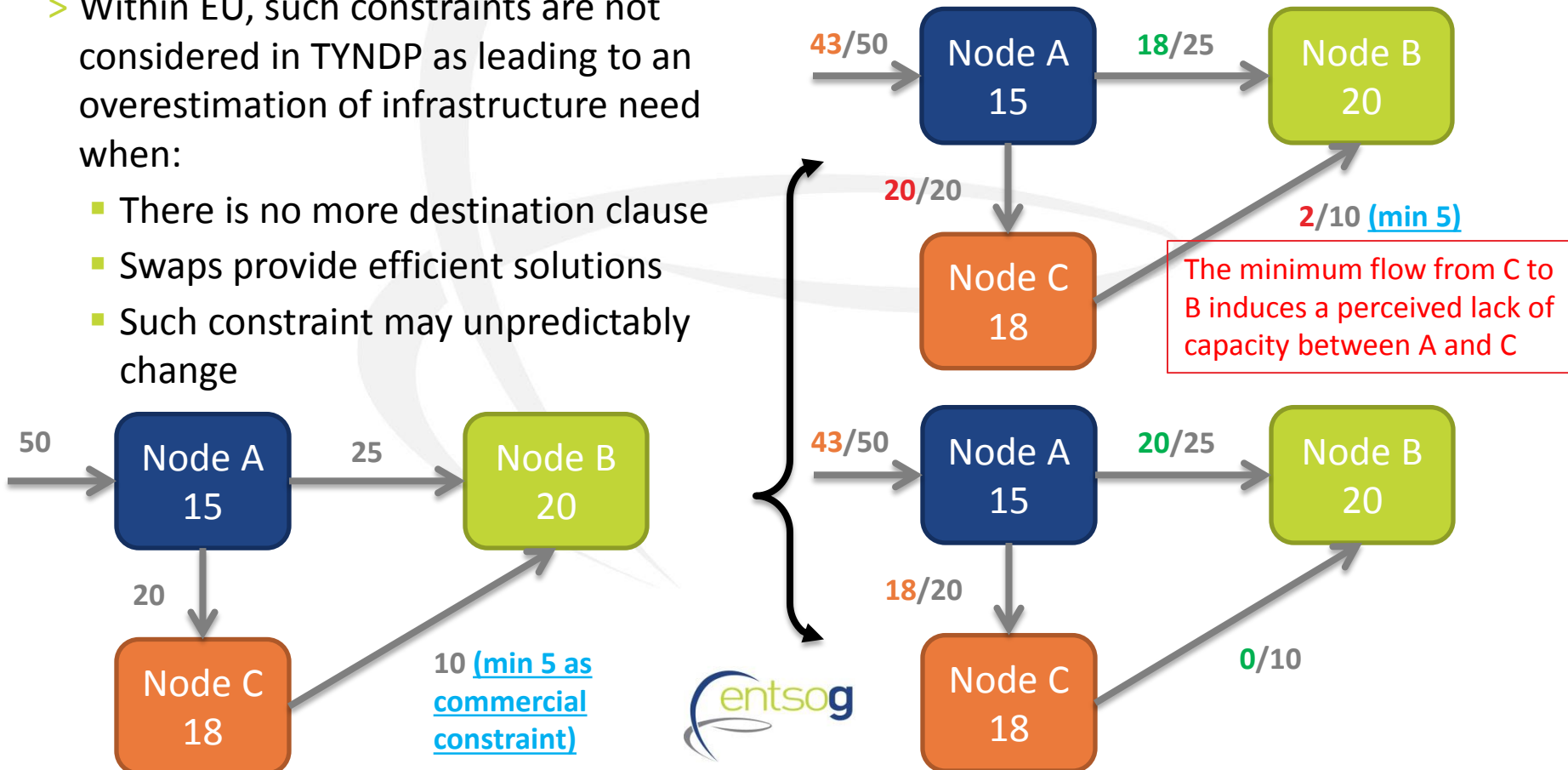> This reduce the complexity of the topology (impacting the time to solve a case) but not result accuracy:

Individual IPs

Aggregated IP

Capacity

Node A — 10 → Node B
Node A — 20 → Node B

Node A — 30 → Node B

Use / Capacity

Node A — 10/10 → Node B
Node A — 15/20 → Node B

Node A — 25/30 → Node B

Node A — 10/10 → Node B
Node A — 20/20 → Node B

Node A — 30/30 → Node B

All possible IP specifics may be transposed to the aggregated one (e.g. minimum flow, specific cost...)

Commercial constraints

Different approaches for EU external and internal borders

> Most of commercial "constraints" can be represented as a minimum flow constraint

> At the external border of EU, such constraints may derived from Take-or-Pay obligations and are actually considered (e.g. use of historical minimum as a proxy)

> Within EU, such constraints are not considered in TYNDP as leading to an overestimation of infrastructure need when:

- There is no more destination clause
- Swaps provide efficient solutions
- Such constraint may unpredictably change

43/50 → Node A 15 → 18/25 → Node B 20

20/20 → Node C 18

2/10 (min 5)

The minimum flow from C to B induces a perceived lack of capacity between A and C

50 → Node A 15 → 25 → Node B 20

20 → Node C 18

10 (min 5 as commercial constraint)

43/50 → Node A 15 → 20/25 → Node B 20

18/20 → Node C 18 → 0/10

entsog

Cost of infrastructure

As a first approach it is proposed to ignore transmission costs as…

> They are of second order compared to supply cost

> Their influence on project benefits will be reduced through the use of the incremental approach

> If revenue could be considered as stable, it is not the case for the derived IP tariff as depending on:
  - Reserve price setting by NRAs
  - Auction results
  - Other revenue recovery mechanisms

> Besides, once booked, capacity is free of charge (except if commodity charge applies)

Situation may differ for UGS

> The equilibrium of storage costs and summer-winter spread influences the way market cover the winter demand

> The influence of the introduction of such cost on the CBA results will be investigated and discussed with stakeholders to check if it useful to be introduced in the methodology

Tool evolution for CBA purpose

Examples

Below examples are based on a limited number of nodes and arcs in order to ease the comprehension of the modelling approach

> Initial situation

> Elasticity of flows

> Power generation: gas vs. coal and CO_2 emissions

> Cost of disruption

> Seasonal dimension

Microsoft Excel
:ro-Enabled Worksl

Next steps

Testing of the tool as part of CBA case-study

> Examples of previous slide will be tested and part of the case-study of SJWS 3 and/or 5

> Such session will provide the opportunity to build stakeholders' trust in the model and to possibly adjust some parameters

> If logic behaviour of the model is to be tested, one should not expect an actual "reality-check" against historical figures:

- as the model assumes a more efficient use of infrastructures
- as many equivalent flow patterns may exist

Thank You for Your Attention

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